In Situ Gasification Chemical Looping Combustion of different biomass types

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Environmental protection and specifically Climate Change, has been become a global problem not only of social responsibility but also an obstacle for economic growth and development. The 5th Assessment Report of the International Panel on Climate Change (IPCC) and the 2015 Paris Agreement conclude it is needed to reduce the Greenhouse Gasses (GHG) emissions and even to develop carbon Negative Emission Technologies (NETs) to limit the global average temperature increase to 2 ºC during the present century.

The energy sector is considered as one of the major contributors to anthropogenic CO_2 emissions. Capture and Storage (CCS) technologies are an interesting technological option to reduce CO_2 emissions from these punctual large emitters. The combination of CCS technologies with the fact that CO_2 emissions from biomass combustion are considered neutral opens the possibility to Bio-Energy with Carbon Capture and Storage (BECCS), a recently proposed alternative among NETs. BECCS development would contribute to achieve Paris Agreement objectives on atmospheric GHG concentrations.

Chemical Looping Combustion (CLC) has been studied during the last decades as a promising capture technology due to the low cost of CO_2 capture and its low energy penalty associated [1]. This technology allows the combustion in a N_2-free atmosphere. The oxygen is transferred to the fuel by a solid Oxygen Carrier (OC) circulating between two fluidized bed reactors. In the fuel reactor the fuel is oxidized and an almost pure CO_2 stream generated. In the air reactor, the oxygen carrier is regenerated in air.

The objective of this work is to analyze the feasibility of the CLC with biomass as a BECCS technology. For that purpose, three biomass residues (pine sawdust, olive stone and almond shell) were evaluated between 900-1000 ºC in a continuous 500 W_{th} unit operating under *In situ* Gasification-Chemical Looping Combustion (*i*G-CLC) mode at *Instituto de Carboquímica* (ICB-CSIC, Spain) with low-cost oxygen carriers.

Combustion parameters and product compositions at the exit of the reactors were studied. CO_2 capture efficiencies were dependent on the fuel reactor temperature, achieving 100 % of carbon capture at the highest temperatures. Further measures should be taken to reduce the amount of unburned compounds at the fuel reactor outlet. NO_x measurements were done and tar emissions were analysed. These results sustain the biomass fuelled *i*G-CLC technology as a promising BECCS technology.

Reference

1. Lyngfelt, A. and B. Leckner, *A 1000MWth boiler for chemical-looping combustion of solid fuels - Discussion of design and costs.* Applied Energy, 2015. **157**: p. 475-487.